



UNIVERSITI PUTRA MALAYSIA

**PERCEPTION TOWARDS A PPLICATION OF GREEN ROOFTOP
AND VERTICAL LANDSCAPE AMONG PROFESSIONALS AND THE
PUBLIC IN TEHRAN CITY, IRAN**

MOHAMMAD REZA TAHERI

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By

MOHAMMAD REZA TAHERI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

September 2008

DEDICATION

**TO MY LATE FATHER AND MOTHER,
MY WIFE, MY SON AND DAUGHTERS**

AND

TO ALL OF MY FRIENDS WHO MARTYRIZED IN WAR

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Doctor of Philosophy

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September 2008

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Faculty: Design and Architecture

The high temperature during the hot season in Iran is the greatest challenge in cooling down residential and commercial buildings in cities because heating and cooling consume the highest amount of energy at the expense of environmental quality. Air pollution, urban heat effect and heat waves, peak energy demands, lack of green space are amongst the most critical environmental issues in Iranian urban areas especially in Tehran. The study implemented a humanistic approach integrated in a qualitative research methodology to develop a green roof strategy for Iran from amongst professional experts and public responses for reducing the high temperature.

This study used in-depth interviews among professionals and public about their perception towards the application of green roof policy and planning, and their related technical; and vertical landscape. Among the factors interviewed include the development of a localized green roof policy, consideration of different weather conditions, adaptation of new irrigation and water supply technologies, selection of plant species, certification, development of an education awareness program, and

mitigation of high capital investment. The study used descriptive analysis where it concluded with several practical recommendations that the authorities could take to improve the social acceptance and implement the educational awareness program. They include creating cultural behaviour towards green roof policy, developing pilot projects with selected public buildings, encouraging participation of non-profit organizations in disseminating information and promoting green roof and vertical landscape, forming a green roof forum combining public and professional participants, adding value to green roof policy, and developing experts and technical support for the implementation. The study also made several specific recommendations for the City of Tehran to implement green roof policy.

In concluding this study, we made several claims where this study 1) extends green roof application to arid and semi-arid climatic zones; 2) identify technical knowledge and educational awareness programs as catalysts to promoting green roof policy in Iran; 3) identifying key components relating to green roof systems, building specifications, irrigation technologies, and selection of plant species for further detailed study; and 4) using a humanistic approach in a research methodology for understanding and identify the challenges and barriers in implementing green roof policy in metropolitan cities of Iran. The implementation of the green roof policy will develop further basis for commercialization of locally-developed research products that are native and carry low maintenance costs while the public will enjoy better quality of life in cities in Iran. Much future studies will be required in promoting such policy, and the establishment of a Green Roof Institute is recommended in Iran to meet this purpose.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat untuk Ijazah Doktor Falsafah

**PERSEPSI TERHADAP APLIKASI BUMBUNG HIJAU DAN
LANDSKAP MENEGAK DI KALANGAN PROFESIONAL DAN ORANG
AWAM DI BANDARAYA TEHRAN, IRAN**

Oleh

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Suhu tinggi semasa musim panas di Iran adalah cabaran utama untuk mendinginkan kediaman dan bangunan pejabat di bandar kerana pemanasan dan pendinginan menggunakan tenaga yang tertinggi yang mencemarkan kualiti alam sekitar. Pencemaran udara, kesan haba perbandaran dan gelombang haba, keperluan tenaga yang tinggi, kekurangan ruangan hijau adalah di antara isu-isu alam sekitar yang kritikal di kawasan perbandaran Iran terutamanya di Tehran. Kajian ini menggunakan pendekatan kemanusiaan dari kalangan pakar professional dan awam yang diintegrasikan di dalam sebuah kaedah penyelidikan kualitatif untuk membangunkan sebuah strategi pelaksanaan polisi bumbung hijau di Iran bagi mengurangkan suhu yang tinggi.

Kajian ini menggunakan temu ramah mendalam di kalangan profesional dan orang awam mengenai persepsi mereka terhadap aplikasi polisi dan perancangan bumbung hijau di Iran dan aspek teknikal yang berkaitan. Di antara faktor-faktor yang ditemui termasuklah pembangunan polisi yang diadaptasikan kepada keadaan tempatan, pertimbangan terhadap keadaan cuaca yang berbeza, mengadaptasikan teknologi

pengairan dan sumber air yang baru, pemilihan spesis tanaman, pensijilan, pembangunan sebuah program pendidikan untuk memperkenalkan teknologi dan polisi bumbung hijau dan mengurangkan pelaburan yang tinggi. Kajian ini menggunakan analisa deskriptif di mana ianya memberikan dapatan yang mencadangkan secara praktikal bagaimana untuk memperbaiki penerimaan sosial dan mengadakan program pendidikan mengenainya. Di antara cadangan tersebut adalah mewujudkan budaya perlakuan yang menyokong polisi bumbung hijau, membangunkan sebuah projek perintis menggunakan beberapa bangunan awam terpilih, menggalakkan penglibatan organisasi bukan kerajaan di dalam menyampaikan maklumat dan mempromosikan bumbung hijau dan landskap menegak, pembentukan sebuah forum bumbung hijau yang melibatkan profesional dan orang awam, menambah nilai kepada polisi tersebut dan membangunkan sumber manusia bagi menjayakan implementasi. Kajian ini turut membuat beberapa cadangan khusus untuk diimplementasi di Bandar Tehran, Iran.

Di akhir kajian, kami ingin membuat beberapa tuntutan di mana kajian ini telah 1) memanjangkan aplikasi bumbung hijau ke zon kering dan separa-kering; 2) mengenalpasti ilmu teknikal dan program pendidikan yang boleh menjadi katalis untuk mempromosikan polisi bumbung hijau di Iran; 3) mengenalpasi komponen utama mengenai sistem bumbung hijau, spesifikasi bangunan, teknologi pengairan, pemilihan spesis tanaman untuk kajian lanjutan dan 4) menggunakan pendekatan kemanusiaan di dalam kaedah penyelidikan untuk memahami dan mengenalpasti cabaran dan rintangan untuk mengimplementasikan polisi bumbung hijau di bandaraya di Iran. Implementasi polisi bumbung hijau ini akan dikembangkan dengan lebih mendalam yang mana boleh menghasilkan produk-produk penyelidikan

tempatan yang dapat dikomersilkan yang mana lebih mesra tempatan dan melibatkan kos penjagaan yang lebih murah selain membolehkan orang awam untuk menikmati kehidupan yang berkualiti di Iran. Lebih banyak kajian turut diperlukan untuk mempromosikan polisi tersebut, dan penubuhan sebuah Institut Kajian Bumbung Hijau adalah dicadangkan di Iran untuk memenuhi objektif tersebut.

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I certify that an Examination Committee has met on 4 July 2008 to conduct the final examination of Mohammad Reza Taheri on his Doctor of Philosophy thesis entitled "Perception Towards Application of Green Rooftop and Vertical Landscape Among Professionals and the Public in Tehran City, Iran" in accordance with Universiti Pertanian Malaysia (Higher degree) Act 1980 and Universiti Pertanian Malaysia (Higher degree) Regulation 1981. The Committee recommends that the student be awarded the Doctor of Philosophy.

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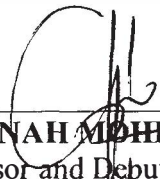
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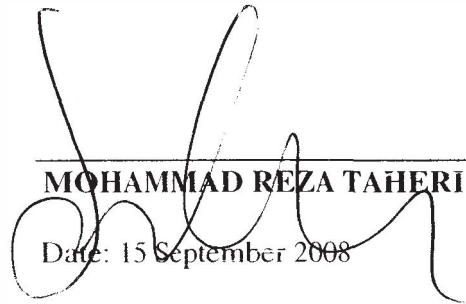
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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.



MOHAMMAD REZA TAHERI
Date: 15 September 2008

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LIST OF ABBREVIATIONS AND ACRONYMS

TEAM	Technology for Early Action Measures
SPSS	Statistical Package for Social Science
KW hr	Kilowatt hour
MRTs	Mean radiation temperatures
ZVG	Germany's Central Horticulture Society
In	inch (1 inch= 2.540 cm)
ft ²	Square feet
ETF	Environmental Task Force
UHI	Urban heat island
dB	Decibel
CO	Carbon Oxidant
IFCO	Iranian Fuel Conservation Organization
SBS	Waterproofing layer product
LAI	Leaf area index
UPM	University Putra Malaysia
EPDM	Waterproofing layer product
CGO	Combined Sewer Overflow
HDB	Singapore Housing and Development Board
Psf	Pound per square foot
CCGT	Chicago Center for Green Technology
EPA	U.S Environmental Protection Agency
USD	United States dollars
PVC	Polyvinyl Chloride
BES	Bureau of Environmental Service
UNESCO	United National Educational
CASBEE	Japanese guideline which contain green roof guide
SEGES	Japanese guideline which contain green roof guide
JPBD	Malaysian's Department of Town and Country Planning
FLL	Germany's research society for landscape construction and development
GALK	The park administrators in the German League of Cities
TPO	Thermal Polyolefin
EPDM	Ethylene Propylene
DAKU	Germany's Green Roof Brand Name

ZinCo	Germany's Green Roof Brand Name
NPB	Singapore National Parks Board
NUS	Singapore National University Singapore
KLIA	Kuala Lumpur International Airport
SCI	Statistic Centre of Iran
NYEIS	New York Ecological Infrastructure Study
B.C	Before Christ
SCM	Sandu Cultural Media (Japanese Publisher)
CHN	Iranian Cultural Heritage News Agency
SGRVLP	Sustainable Green Roof and Vertical Landscape Planning

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CHAPTER 1

INTRODUCTION

Iran has a surface area of 1.648.000 km² and lies between 25 and 40 degree latitude. Nearly, 23% of this surface is completely covered by deserts. Plateau of Iran enjoys a relatively dry climate with average annual precipitation of 275mm considering these climatic points; the crucial importance of green-spaces-development in Iran becomes more obvious. Moreover, with the excessive urbanization, the population explosion in the cities of Iran, the increase of the land price in recent years, and the construction of buildings on unequal surfaces in height, the extension and employment of green spaces in the cities has decreased notably and has become one of the most challenged issues in the country. Besides this, concentration of buildings in cities triggers various environmental problems such as urban heat effect. The increase in urban heat effect is mainly due to the loss of green spaces and consequently caused climate change in urban areas.

In the development of green spaces, the employment of *green roof* and *vertical landscape* has become a preferred choice where the access to enough spaces and land is limited for employment of traditional yards, especially in residential condominiums and high rise buildings. The term green roof refers to planned vegetation on the rooftop. It can be divided into two groups: extensive and intensive. Green roof is also defined as 'contained' green spaces on top of human-made structures (Peck, et al., 1999; Boivin & Challies 1998; Osmundson, 1999; Nielsen, 2004). Vertical landscape involves growing plants on walls. It includes vertical green, bio-lung, vertical garden, facade greening, bio-wall, living wall, green wall